Medical School Hotline

Encoding Specificity and Problem-Based Learning (PBL)

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The John A. Burns School of Medicine (JABSOM) is completing its tenth year of Problem-Based Learning (PBL). In reflecting on the dramatic changes in the ways students learn, the educational principle of encoding specificity is significant. Howard Barrows (1985) noted that upon entering their third year clerkships, medical students in schools with traditional, lecture-based curricula do not remember or cannot apply what they were taught in the basic sciences. Schmidt (1983) suggested that this failure is due to the lack of encoding specificity. Schmidt has argued that the closer the resemblance between how something is learned and how it is used determines how well it is remembered and how well it is applied.

The lack of encoding specificity is apparent in traditional models for the teaching of microbiology. When JABSOM began in the late 1960's, students were given sequential lectures in bacteriology, virology, mycology and parasitology. The Department of Tropical Medicine and Medical Microbiology consisted of bacteriologists, virologists, and several parasitologists. The bacteriologists began their lectures series with the Gram (+) cocci, then moved to the Gram (-) cocci, and ended with lectures on the spirochetes. These presentations were followed by lectures by virologists and parasitologists. While useful to graduate students, who took the same course, this taxonomic and morphologic organization was not always useful for medical students who were preparing for their third year clerkships and expected to solve clinical problems and make clinical diagnoses.

In the PBL curriculum, medical students learn microbiology in a model whereby in the first unit (15 weeks), students study ten clinical cases. Three are microbiological: streptococcal pharyngitis, hepatitis B, and leprosy. While these microorganisms seem unrelated and the observer may conclude that students are learning microbiology in a piecemeal fashion, students focus on large, organizing concepts of infectious disease. With the case of pharyngitis, they learn the cardinal signs and symptoms of acute infection and inflammation. The hepatitis B case introduces the concept of viruses as pathogens, and students learn the clinical signs and symptoms of viral infection. In the third microbiology case, students study leprosy and learn to recognize slowly developing, subacute chronic infections from the rapidly developing, acute, febrile illness. The three cases introduce concepts of acute vs chronic infection, bacterial vs. viral infection, and humoral vs. cell-mediated immunity.

PBL Units 2-4 are organ-system based. The encoding of new information begins in these units. Unit 2 consists of a month each of cardiovascular, respiratory and renal problems. The respiratory subunit includes two infectious disease problems. The patient, Bob Kim, presents with fever, chest pain and shortness of breath for the past three days. Students now ask: Does Mr. Kim suffers from an acute or chronic infection? If acute, they ask and learn what organisms are in the differential diagnosis for acute, community-acquired pneumonia. The problem continues. Students learn that Mr. Kim has productive cough and consolidation in the right lower lobe. They begin to learn the differences between typical and atypical pneumonias. Students study the various bacteria that result in pneumonias with productive cough and consolidation: *S. pneumoniae, H. influenzae,* and *S. aureus*. They also learn about the atypical pneumonia caused by *Mycoplasma pneumoniae*, Chlamydia pneumoniae, and influenza. Mr. Kim turns out to be an alcoholic and a 40 pack-year smoker. Students learn about community-acquired pneumonias in immunocompromised individuals caused by *Klebsiella pneumoniae* and *Legionella pneumophila.* As students progress through the curricular units, they learn about urinary tract infections, GI infections, musculo-skeletal infections, CNS infections. Students in the PBL curriculum learn about microorganisms, as these would emerge in the clinical setting. They encode new information in ways that will be useful as clinicians.

In 1983, a commission of basic scientists, clinicians, Deans, and leaders in medical education met to discuss the effectiveness of traditional medical teaching methods. One participant argued, "a major problem is that integration of new information acquired in the pre-clinical years is expected to occur automatically in the clinical years" (Muller, 1984). Third year ward clerks taught microbiology in a traditional curriculum are expected to reorganize the various bacteria, viruses, fungi and parasites into clinically relevant groups. But there is little time in the third year to sort out those bacteria, viruses and fungi that cause typical, productive pneumonias from those that cause atypical pneumonia. Medical faculty supervising third year clerks expect that this knowledge has already occurred in the first two years.

On a personal note, the author began teaching bacteriology in 1986, using the traditional lecture format. This is the way he had been taught as a basic scientist; it is the way he knew the material best; and it is how he assumed medical students should learn it. When he began teaching third year medical students and quizzed them about what they had learned, he was astonished to see how little they remembered.

Ten years after switching to PBL at JABSOM, faculty in the Office of Medical Education better understand principles of education and how medical students learn. Faculty have reported, as Schmidt did in 1983, that new information is best retained if it is assimilated in ways that it will be used.

Now basic scientists are beginning to think like clinicians and to teach basic science to medical students clinically relevant ways. It is expected that will be better retained and applied in clinical problem solving.

References

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